Technician Anastasia Hammond distills formaldehyde from cotton samples at the Southern lab.

Cotton Products: Last 20 Years

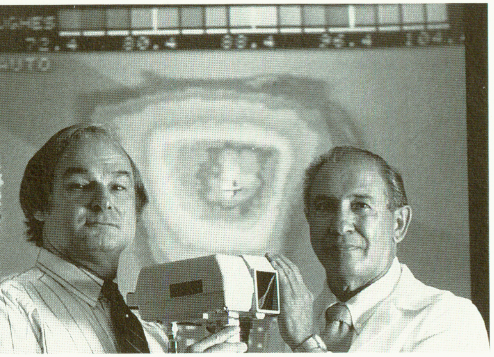
The most important invention of cotton researchers at the New Orleans laboratory during the last two decades is, in the opinion of the Center's current director, a durable-press finish for cotton fabrics that poses no health risk for textile workers. The process, developed during the 1980's, replaces traditional textile-finishing chemicals with new ones that do not release formaldehyde in the workplace.

The Occupational Health and Safety Administration, a Federal agency that monitors the safety of working conditions, has set strict limits on allowable exposure of workers to formaldehyde, which has been identified as a probable human carcinogen. Even though only minute amounts of formaldehyde are released in the process currently in use, the industry would welcome a safer way to impart durable press to cotton.

The SRRC researchers who developed the safer process found a new way to cross-link cotton fibers using citric acid, a polycarboxylic acid. This produces an entirely different kind of chemical bond from that formed during traditional finishing, but one that still forms cross links that reduce wrinkling. One key to the success of the invention over earlier attempts to develop formaldehyde-free finishing is the use of new inorganic catalysts to promote the cross-linking reaction.

The improved process, which keeps cotton fabrics wrinkle-free for more than 100 washings, was patented by USDA in 1990. Several companies quickly applied for a license to commercialize the technology.

Core-yarn Fabrics. Outdoor fabrics that are light, strong, durable, and flame resistant made with core-spun yarn have been developed by SRRC scientists. The fabrics are especially useful for tents and tarpaulins, since their high cotton content ensures breathability and eliminates the sweating and dripping often experienced with synthetics. The core of the yarn is a



SRRC research chemists Tyrone Vigo (left) and Joseph Bruno developed temperature-adaptable fabrics with built-in chemical thermostats. Here they use an infrared camera to measure the surface temperature of a fabric sample placed in front of a heat source.

continuous filament of glass that is wrapped with a blend that is 60 to 90 percent cotton. Fabrics look and feel like 100 percent cotton but are more resistant to sunlight and mildew. Research is continuing to develop specialized core-yarn fabrics for military uses.

Improved Cotton Dyeing. For several years, it was impossible to dye cotton fabrics with durable press properties after their manufacture into garments. This was a matter of concern, since garment dyeing is used increasingly by the textile industry to reduce inventories and to react quickly to new color trends. A new additive, choline chloride, was found by SRRC scientists to render durable press fabrics dyeable with several classes of dyes. The USDA patent for this technology has been licensed. Several other dyeing innovations for cotton fabrics have come from the Southern laboratory in recent years. One is differential piece dyeing, in which the entire fabric is dyed but only selected areas, previously treated chemically, absorb the color. Another patented technique produces a garment that resembles a home-made tie-dyed shirt.

Heat-Transfer Printing. Until SRRC researchers solved the problem, cotton T-shirts could not be printed with those heat-transfer cartoons and slogans that help establish the identity of people who stroll the boardwalks and beaches. The disperse dye, which vaporizes when heated, had an affinity only for polyester fibers. Now cotton fabrics can be chemically modified so that specific disperse dyes used in the design on paper will, when heated, interact with the chemical agent and transfer to the cotton. The chemical also cross-links the cellulose and gives the cotton smooth drying properties.

Antibacterial Cotton Fibers. Bacteria that produce body odors or transmit disease can reside and multiply in textile fabrics. This is particularly undesirable in medical clinics and hospitals. No fiber, cotton, wool, or synthetic, has any inherent resistance to bacterial growth. SRRC researchers have developed treatments for cotton textiles with compounds containing peroxides that resist bacteria and, as a bonus, resist fungi that cause athlete's foot. One treatment, Permox, is inexpensive and effective against a variety of bacteria. It can be used on cotton and cotton-blends and will withstand repeated launderings.

Temperature-Adaptable Fabrics. Cotton and other fibers absorb and release some heat. Two SRRC researchers have found a way to attach polyethylene glycols, called PEG's for short, to cotton and other fabrics. Garments so treated respond to changes in temperature; they release heat when it is cool and absorb it when it is warm. The amount of heat that a garment will store and release depends on the kind of fabric material, the chemical applied, and the amount applied. A patent for the process has been licensed in the United States and abroad.

Cotton in Nonwoven Constructions. The nonwoven textile industry, which consumes more than 2.3 billion pounds of fiber a year, uses comparatively little cotton. The three leading fibers are polyolefins, polyesters, and rayons, and they are used to make such nonwoven products as diapers, dusting and wiping cloths, and hospital and surgical gowns, masks, and other disposable items. SRRC research has demonstrated that it is technically feasible to make heat-bonded nonwoven fabrics from high cotton blends. Cotton's most favorable properties of comfort, feel, softness, and absorbency can be incorporated into these fabrics. Waste disposal, a national concern of the heavily synthetic oriented nonwoven industry, is not a problem with cotton, since it is biodegradable.

Cellulose III Cotton Fiber. A fiber developed at SRRC during the 1980's is a rare crystalline form of cellulose capable of improving the resistance to wear of durable press cotton. Derived from native cotton, Cellulose III is highly stable and is permeable by dyes, pigments, and other chemicals used in textile processing. It is created by treating plain cotton cellulose with ammonia vapors and high temperature and pressure until its crystalline structure changes. The alterations in geometric configuration can be observed by X-ray diffraction. It is still a costly laboratory creation, but researchers are looking for less expensive ways to mass produce the fiber.